MERCURY TMDLS FOR SUBSEGMENTS WITHIN MERMENTAU AND VERMILION-TECHE RIVER BASINS

Including Subsegments

050101 - Bayou Des Cannes
050201 - Bayou Plaquemine Brule
050702 - Seventh Ward Canal
050901 - Mermentau River Basin Gulf Waters
060203 - Chicot Lake
061201 - Vermilion-Teche River Basin Gulf Waters

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Watershed Management Section
Water Quality Protection Division

with cooperation from

Louisiana Department of Environmental Quality
Office of Environmental Assessment
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MERCURY TMDLS FOR SUBSEGMENTS WITHIN MERMENTAU AND VERMILION-TECHE RIVER BASINS

Executive Summary

Section 303(d) of the Federal Clean Water Act requires states to identify water bodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those water bodies. A total maximum daily load (TMDL) is the amount of a pollutant that a water body can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and non-point sources discharging to the water body. This document includes TMDLs for the Mermentau and Vermilion-Teche basins. The Mermentau basin TMDL addresses four segments listed for mercury, including Bayou Des Cannes (subsegment 050101), Bayou Plaquemine Brule (subsegment 050201), Seventh Ward Canal (an unclassified subsegment of 050702) and a portion of the Gulf of Mexico (subsegment 050901). The Vermilion-Teche TMDL addresses two subsegments listed for mercury, including Chicot Lake (subsegment 060203) and a portion of the Gulf of Mexico (subsegment 061201).

The above subsegments were listed by the state due to excessive levels of mercury in edible tissues of one or more fish species. The data used to make this determination was collected as part of a state-wide study of mercury contaminant levels in Louisiana biota, sediments and surface waters. Fish consumption advisories were issued by the state based on the risk from long-term consumption by the general population and sensitive sub-populations. Issuance of a fish consumption advisory indicates non-support of the state water quality standards. The standards state that "no substances shall be present in the waters of the state or the sediments underlying said waters in quantities that alone or in combination will be toxic to human, plant or animal life *or significantly increase health risks due to exposure to substances or consumption of contaminated fish or other aquatic life*." These TMDLs are intended to achieve the "fishable" beneficial use over time.

These TMDLs take into account mercury bioaccumulation observed in all six segments collectively. This is justified since EPA and the state believe that atmospheric deposition is the predominant source of mercury. Atmospheric deposition includes a combination of local, regional scale and background (global) inputs. Here the highest average tissue concentration for the species and water bodies sampled served as a "worst case" measure of bioaccumulation. The water body and species with the worst case average tissue concentration was bowfin in Bayou Plaquemine Brule. The ratio of this concentration (1.191 ppm) to the "safe" tissue concentration of 0.4 ppm (the risk based fish tissue concentration of 0.5 ppm, factoring in a 20% margin of safety) indicates that a three-fold reduction (67%) in loading is needed. This assumes a linear relationship between atmospheric loading and resulting bioaccumulation. The target

wet deposition loading rate for both basins, calculated as one third of the National Mercury Deposition Program (NMDP) wet deposition data, was 79.6 ng/m^2/wk (11.4 ng/m^2/day). The targeted daily loads, calculated based on drainage area and point source discharges, are summarized as follows:

River Basin		Estimate of Existing Loads		Total Maximum Daily Load	
Mermentau Basin					
		Annual Load	Daily Load	Annual Load	Daily Load
Loads	Wet Deposition	124.5 kg/yr	(341 g/d)	41.6 kg/yr*	(114 g/d)
	Dry Deposition	41.5 kg/yr	(114 g/d)	13.9 kg/yr	(38 g/d)
Wasteload (Point Sources)		0.7 kg/yr	(2.01g/d)	<0.7 kg/yr	(<2.01 g/d)
Total		166.8 kg/yr	(457 g/d)	56.2 kg/yr	(154 g/d)
Vermilion-Teche Basin					
Loads	Wet Deposition	130.3 kg/yr	(357 g/d)	43.4 kg/yr*	(119 g/d)
	Dry Deposition	43.4 kg/yr	(119 g/d)	14.5 kg/yr	(40 g/d)
Wasteload (Point Sources)		2.7 kg/yr	(7.39 g/d)	2.7 kg/yr	(<7.39 g/d)
Total		176.4 kg/yr	(483 g/d)	60.6 kg/yr	(166 g/d)

*Target Parameter for TMDLs.

A ten year implementation schedule (completion by 2010) is projected. This reduction strategy is in line with the Binational Toxics Strategy, which sets a national challenge of 50% reduction of mercury releases to the air by 2006. This level is therefore set as an interim goal relative to the TMDLs addressed here. The state, in conjunction with other stakeholders, will develop implementation and monitoring plans for these TMDLs. Wet deposition is the target TMDL parameter. Monitoring of wet deposition will be continued and will serve to establish trends. Monitoring of fish tissue for predator species in affected water bodies will be conducted on an ongoing basis. Wet deposition rate and fish tissue body burdens will serve as the primary indicators to evaluate the effectiveness of these TMDLs.

The ten-year time frame for implementation allows for Clean Air Act regulatory controls, as well as needed research to be conducted on mercury control technology. Both improved technology and best management practices, including product substitutions, are important means of reducing mercury inputs. Implementation should result in reductions in fish tissue levels, and eventual attainment of the fishable use for the "worst case" water body, as well as other listed segments. Due to recycling of mercury within water bodies, continued influx of mercury previously deposited on the land surface, and continued inputs from the global mercury reservoir, attainment is expected to take several decades. These TMDLs will be reassessed as needed and modified or superceded based on available data, guidance and national strategies. To the extent possible, TMDLs will parallel national regulations, strategies and initiatives to reduce mercury releases.

1. Introduction

The Louisiana Section 1998 303(d) list includes six segments targeted for mercury Total Maximum Daily Loads (TMDLs) in the Mermentau and Vermilion-Teche basins. Mercury was identified as a problem due to bioaccumulation in fish tissue. The suspected cause is atmospheric deposition (LDEQ 1998a, b). The subsegments addressed include the following:

Mermentau River Basin

(1) Bayou Des Cannes - Headwaters to Mermentau River, Subsegment 050101

(2) Bayou Plaquemine Brule - Headwaters to Bayou Des Cannes, Subsegment 050201

(3) Seventh Ward Canal - unclassified component of Subsegment 050702

(4) Mermentau River Basin Gulf Waters to 3-mile Limit, Subsegment 050901

Vermilion-Teche River Basin

(1) Chicot Lake, Subsegment 060203

(2) Vermilion-Teche River Basin Gulf Waters to 3-mile Limit, Subsegment 061201

These subsegments were targeted based on the results of a state-wide assessment of mercury in fish tissue and corresponding assessment of human health risks associated with consumption of fish tissue. Elevated concentrations of mercury in fish tissue resulted in the state issuing fish consumption advisories for these six segments (LDEQ 1998b). All of these segments have a priority ranking of 1, and were targeted for completion in calendar year 1999.

The purpose of a TMDL is to determine the pollutant loading that a water body can assimilate without exceeding the water quality standard for that pollutant. The TMDL also establishes the load reduction that is necessary to meet the standard in a water body. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load allocated to non-point sources. The MOS is a percentage of the TMDL that accounts for the uncertainty in the relationship between the pollutant loads and the quality of the receiving water body. This document constitutes TMDLs applicable to six subsegments listed for mercury. However, due to similarities in the bioaccumulation observed, and the broad areal scope of the problem, they were addressed collectively. TMDLs were developed for Mermentau and Vermilion-Teche basins which include the listed water bodies.

2. Water Body Description and Pollutant of Concern

Information on the listed segments, monitoring sites, and watershed area is presented in Table 1 and Figure 1. The Mermentau and Vermilion-Teche basins are located in the Western Gulf Coastal Plain and Coastal Chenier Plain ecoregions of the state. These basins are located in southwestern and south central portions of Louisiana. The freshwater subsegments tend to be low gradient, swampy systems. At times these segments are characterized by low dissolved oxygen. Both Bayou Plaquemine Brule and Chicot Lake are also identified on the state's Section 303(d) list for organic enrichment and low dissolved oxygen (LDEQ 1998a). In both basins, the area is rural, with agriculture being the predominant land use. Urban land use represents less than 5% of the basins' total land use. Due to the lack of extraction activities (<0.2% of the total land use), the effect of mining is not believed to be significant source of mercury in these basins.

Potential mercury sources include releases of natural mercury deposits in soil and sediment within the watershed, municipal wastewater dischargers, industrial dischargers, oil and gas extraction activities, as well as local and far-field atmospheric sources including coal-fired boilers, chlor-alkali plants, and municipal waste combustors (MWCs) and medical waste incinerators (MWIs). Mercury emitted from anthropogenic sources usually contains both gaseous elemental mercury (Hg(0)) and divalent mercury (HG(II)).

Most of the mercury which bioaccumulates in fish tissue is in the form of methyl mercury. Demethylation reactions and volatilizaion can decrease the levels of methylmercury in the aquatic environment. As a chemical element mercury can not be created nor destroyed, however, it can cycle in the environment as a result of both natural and anthropogenic activities. Factors which can influence the rate and degree of bioaccumulation of mercury in aquatic biota include acidity of the water (pH), length of the food chain, temperature, dissolved organic matter, soil type and erosion. Water pH often correlates with mercury tissue concentrations (LDEQ 1995; TNRCC 2000), however, the interrelationships of these factors is poorly understood (EPA 1997).

Measured data and modeling indicate that the amount of mercury mobilized and released into the biosphere has increased since the beginning of the industrial age. The presence of methyl mercury in fish is, in part, due to the anthropogenic mercury releases from industrial and combustion sources. The flux of mercury from the atmosphere to land and water is comprised of the global reservoir (combination of natural and anthropogenic sources), regional and local (<50 miles away) contributions.

The TMDLs would serve to inventory potential sources of mercury which could contribute significant quantities of mercury in these watersheds. The TMDLs will also include monitoring of contributing point sources to the listed

waters to assess mercury contributions. Based on a national review of available data and information (EPA 1997), EPA Region 6 and the Louisiana Department of Environmental Quality (LDEQ) believe atmospheric contributions of mercury are the most significant sources in Louisiana, and that these air emissions originate both outside and within these watersheds. However, other point and non-point sources contribute to the atmospheric mercury loads. EPA Region 6 believes that the three Mercury Deposition Network Program (MDNP) stations (see Figure 1) located in the state are representative of the range of deposition within the Mermentau and Vermilion-Teche basins.

Mercury TMDLs applicable to the listed subsegments in the two river basins are addressed in a collective fashion in this document. The rationale for addressing multiple subsegments collectively is that (1) available monitoring and research indicate that mercury is transported in the atmosphere over great distances, indicating the need for a broader state-wide or basin-wide rather than a water body specific approach; (2) available information suggests that point source waste water discharges of mercury are negligible; and (3) there are similarities in the fish species, and the mode and degree of bioaccumulation observed in these waters. The six subsegments are likely affected similarly from wet and dry atmospheric loading of mercury, although water body type, geology, drainage areas and site specific physico-chemical characteristics differ between segments. These differences, however, do not preclude the use of the multi-segment, watershed scale TMDL approach. The subsegments, species affected by state-issued fish consumption advisories (and therefore listed under Section 303(d)), and average tissue concentrations by species are presented in Table 1.

Since atmospheric deposition influences all watersheds in these two basins, no true reference stations, devoid of this source, exist. However, due to site specific characteristics, some waters are more prone to bioaccumulation of mercury than others. Some waters within the Mermentau and Vermilion-Teche basins have very low tissue concentrations of mercury, in the range of 0.1-0.2 ppm in predator species. These waters are also subject to atmospheric deposition, but by virtue of site specific chemical, physical and biological processes, are less vulnerable to bioaccumulation. Variables which in some cases influence bioaccumulation include pH, sulfate and total organic carbon (TOC) levels (LDEQ 1995; TNRCC 2000). A watershed scale, rather than a water body specific TMDL approach is intended to result in eventual water quality standards attainment of targeted waters. A secondary benefit to a watershed approach is protection of those waters which may be threatened by mercury contamination.

3. Applicable Water Quality Standards and Targets

The need for addressing mercury in the identified segments relates to both the narrative (“no toxics”) water quality standards, and the numeric water quality standard for mercury. The narrative standard states that “no substances shall

be present in the waters of the state or the sediments underlying said waters in quantities that alone or in combination will be toxic to human, plant or animal life or significantly increase health risks due to exposure to substances or consumption of contaminated fish or other aquatic life" (LDEQ 2000). The numeric water quality standards for protection of aquatic life are 0.012 ug/l for freshwaters and 0.025 ug/l for marine waters. The state of Louisiana has not yet adopted a bioaccumulation based mercury water quality standard for protection of human health. To accurately assess ambient water mercury concentrations, "ultra-clean" (contaminant-free) sample collection and analysis techniques are necessary. Historical mercury-in-water data is of suspect quality since ultra-clean techniques were not used in the past. Based on mercury's high bioaccumulation factor (BAF = 6,800,000; EPA 1997), significant bioaccumulation is possible at concentrations below the water quality criterion, as has been found in the Florida everglades (EPA Region 4 1996).

Because the state has not yet adopted human health water quality standards, which address the bioaccumulative tendency of mercury, the TMDLs utilize fish tissue as a direct indicator of bioaccumulation and human health risk. For these TMDLs EPA Region 6 is implementing the state's narrative water quality standards. A tissue concentration of 0.5 ppm wet weight, with an explicit safety factor of 20% (resulting in a value of 0.4 ppm) is utilized as a target endpoint to assure compliance with the narrative water quality standards. A concentration of 0.5 ppm wet weight or higher triggers issuance of fish consumption advisories (Dr. Bill Hartley, Tulane University, personal communication). At this concentration there is significant risk to children and women which may be of child-bearing age, which are pregnant or are nursing. The fetus is particularly sensitive to the neurotoxic effects of methyl mercury.

The goal of these TMDLs is to attain both the "fishable use" (see Clean Water Act Section 101(a)) and narrative water quality standards. The waters identified here were listed based on elevated tissue mercury concentrations. Mercury-in-fish is a direct indicator of risk to human health. Guidance issued October 24, 2000 by the EPA Office of Science and Technology and Office of Wetlands, Oceans and Watersheds states that EPA generally believes that fish and shellfish advisories demonstrate an impairment of the CWA section 101(a) "fishable" use. This applies to fish and shellfish consumption advisories and certain shellfish area classifications for all pollutants that constitute potential risks to human health, regardless of the source of the pollutant. The guidance indicates that a fish consumption advisory is a demonstration that the water body is impaired and should be included on a section 303(d) list when the risk assessment parameters (e.g., toxicity, risk level, exposure duration and consumption rate) are equal to or less protective than water quality standards. This interpretation is applicable to the Mermentau and Vermilion-Teche basins since the state has not yet adopted mercury water quality standards for protection of human health.

To evaluate the appropriateness of the state's action level for issuing fish advisories a separate screening level was calculated using EPA guidance. Fish tissue screening levels can be derived using EPA guidance for assessing

contaminant data for fish consumption advisories (EPA 1995). Assuming a consumption rate of 20 grams per day (0.02 kg/d, the assumed consumption rate for Louisiana's human health water quality standards), a body weight of 70 kg, and a reference dose (RfD) of 0.0001 mg/kg/d, and utilizing the equation of SV_n = (RfD * BW)/CR, a non-carcinogenic screening value (SV_n) of 0.35 ppm wet weight is obtained. This screening value is consistent with the target endpoint that was utilized for the TMDLs (rounded to 0.4 ppm). The above RfD has been solidified based on the recent National Academy of Sciences toxicological assessment of mercury. The NAS study upheld EPA's original recommendation of 0.0001 mg/kg/d. This RfD is also used by the Louisiana Department of Health and Hospitals in deriving consumption advice for children and women of child-bearing age (Dr. Bill Hartley, Tulane University, personal communication). The EPA Office of Water has developed a human health criteria guidance document for mercury (EPA 2001). The guidance establishes a fish tissue criterion of 0.3 ppm wet weight for methylmercury. The target of 0.4 ppm wet weight total mercury used in these TMDLs is relatively consistent with the above screening level of 0.35 ppm and the EPA fish tissue criterion of 0.3 ppm.

Mercury bioaccumulation is also a potential risk for piscivorus wildlife (e.g., bald eagle, raccoon and great blue heron) (USFWS 1987; 1997). Very little information is available on the extent of mercury bioaccumulation in Louisiana wildlife. EPA believes that this initial TMDL which addresses human health risk will also result in reductions in risk to piscivorus wildlife.

4. Loading Capacity and TMDL Formulation

The loading capacity of water bodies differs on a site specific basis due to both inputs of mercury and physical, chemical, and biological variables which mediate bioaccumulation. In the future, refinement of water quality standards and implementation of ultra-clean sampling and analytical techniques may facilitate the estimation of loading capacity through water column monitoring. Presently, due to the cumulative nature of mercury, fish tissue concentration is the best indicator of whether loading capacity has been exceeded

The state of Louisiana issues fish consumption advisories for mercury where the fish tissue concentrations for one or more species commonly consumed is equal to or greater than 0.5 ppm. These advisories, recommending consumption limitations of some species--and in some cases, no consumption--apply to pregnant or nursing women and to children under 7 years of age (LDEQ 1998b). In order for an advisory to be rescinded, and the "fishable" use to be attained, all species should be safe for human consumption. The fish species with the highest average concentrations of mercury which are included under advisory are presented in Table 2. Fish consumption advisories hinge on these predator species due to bioaccumulation, and biomagnification in higher trophic levels.

If the body burden of the primary species of concern are reduced to <0.5 ppm, the water bodies would be in attainment of the "fishable" use. Therefore, the loading capacity represents the target (safe) tissue level of 0.4 ppm. Here we assume a linear relationship between source reduction and fish tissue reductions of mercury. Modeling results by EPA support a plausible link between mercury emissions from anthropogenic combustion and industrial sources and methylmercury concentrations in freshwater fish (EPA 1997). In order to establish the degree of mercury reduction needed in key species, the "worst case" body burden was divided by the target (safe) tissue concentration level. The "worst case" body burden was the highest average concentration of filet samples for predator species sampled from the listed waters (Table 2; LDEQ 1998b). Here a hazard quotient is directly applied to estimate load reduction (RF). This is illustrated by the following equation:

RF=MC/SC, where

RF=Reduction Factor (dimension-less)
MC=Measured Concentration ("worst case" fish tissue conc., avg. in ppm wet weight)
SC=Safe Concentration (risk based fish tissue conc., with margin of safety, in ppm wet weight)

and, $TMDL = \frac{EL}{RF} \times SF$, where

TMDL=Total Maximum Daily Load (avg. loads and waste loads in kg/yr or g/d)
RF=Reduction Factor
EL=Existing Total Load (avg. loads and waste loads in kg/yr or g/d)
SF=Site Specific Factor(s) (requires study; in this case assumed to be 1)

The reduction factor is calculated as 1.191/0.4 = 2.97. This approach indicates that mercury loads would have to decrease three-fold, or 67%, to ensure standards attainment over time. If this load reduction is achieved, standards should be attained for Bayou Plaquemine Brule as well as the other listed waters. Therefore, for all six of these water bodies, the TMDL will constitute a three-fold (67%) reduction in mercury loading.

Atmospheric deposition of pollutants has been identified as an important process contributing to mercury and other air toxic emissions in the aquatic environment. Research has shown that there are three fractions for airborne delivery pathways of atmospheric pollutants to water bodies: (1) a local fraction (local scale), originating within a radius of 50 miles; (2) a long-range fraction (regional scale), originating greater distances away from the waters of concern; and (3) the global fraction, consisting of background concentration which is transported great distances. These sources contribute to the total load. The three-fold reduction is proposed for local and long-range atmospheric sources.

Table 3 presents data from the state's participation in the national mercury deposition network (MDNP). Mercury wet deposition data is available for five quarters (4th quarter 1998; 1st through 4th quarters of 1999) at three stations, LA10 (Chase), LA12 (=LA05, Lake Charles) and LA28 (Hammond) (see Figure 1). In general, deposition was lowest in the fall, higher in the winter, and highest in the spring. The overall average of mercury wet deposition rate (mean of the three stations) was 238.9 $ng/m^2/wk$, or 34.1 $ng/m^2/day$. This loading rate and the drainage area for each basin were used in calculating basin-specific atmospheric loads for the Mermentau and Vermilion-Teche basins. Drainage areas are 3860.1square miles (9.997613 x 10^9square meters) for the Mermentau basin, and 4038.65 square miles (1.046006 x 10^{10} square meters) for the Vermilion-Teche basin. Point source contributions were calculated from information obtained from EPA's Permit Compliance System (PCS). An existing wasteload was calculated using discharge flow and an assumed concentration of 15 ng/l mercury for all discharges. This assumed concentration was based on data collected by the Arkansas Department of Environmental Quality on municipal discharges in Arkansas using low detection analytical techniques (ADEQ 1995). Design flows were used where available and assumed flows of 2 million gallons per day (MGD) for majors and 0.1 MGD for minors were applied where discharge data was lacking. Point source contributions were summed to derive existing wasteloads for each basin. Existing and targeted loads are presented in Table 4. As indicated in the table, point source contributions represent a relatively small proportion of the total load (0.6% and 1.5% for Mermentau and Vermilion-Teche basins, respectively).

Target deposition rates and basin-specific atmospheric loads are essentially one third of the existing values. Thus, the TMDLs would primarily target reductions in wet deposition. The TMDLs would also target reductions in point sources, which may have reasonable potential to violate narrative or numeric water quality standards on a site specific basis.

At this time use of a simple approach to initiate targeted reductions of atmospheric mercury is preferable to a complex modeling approach. While more sophisticated procedures and supporting guidance will eventually be developed on a national basis, this TMDL approach is considered most appropriate in the interim. Future efforts may take into account speciation and transformation of mercury, recycling of mercury within aquatic ecosystems, re-emission of deposited mercury and site specific factors which can influence mercury bioaccumulation. The TMDLs do not specify a critical period. Fish tissue concentrations of mercury are integrated over time and concentrations are relatively stable. Slight, but insignificant changes in tissue concentrations may take place as a function of season (e.g., due to seasonal overturn; seasonal inundation of organic soils; higher feeding rates by fish in warm weather months) or flow regimes. Mercury body burden is more dependent on long-term mercury loading and rates of mercury methylation than on short-term variations in environmental factors. Therefore, long-term (e.g., mean annual loads) rather than specified critical conditions are of concern in these TMDLs.

5. Sources

A review of the Permit Compliance System (PCS) database indicates that 94 facilities discharge to waters within the Mermentau basin and 437 facilities discharge to the Vermilion-Teche Basin. Total discharges for these basins were 29.59 and 130.19 million gallons per day (MDG), respectively. The majority of these facilities are municipal discharges. Due to lack of discharger data, a concentration of 15 ng/l for these discharges was assumed for loading calculations (ADEQ 1995).

To evaluate air emissions, data was retrieved from the EPA Toxics Release Inventory (TRI), and the Louisiana Toxic Emissions Data Inventory (TEDI). These data are contained in Tables 5 and 6, respectively. For purposes of these TMDLs, facilities located 100 km around the perimeter of the watersheds were extracted from the databases. These databases include only those facilities required to report to the state and EPA, thus, they do not include small emitters and coal-fired power plants. TEDI listed a total of 1411 pounds/year (640.6 kg/year). The most significant emitter was PPG Industries in Lake Charles, which emitted 1222 pounds (554.8 kg/yr) in 1999.

A combination of activities is expected to reduce mercury emissions to the air over the next decade. EPA regulates mercury emissions to the air under Section 112 of the Clean Air Act. Section 112 authorizes EPA to address major sources of hazardous air pollutants, including mercury, by issuing emissions limits that are at least as stringent as the emissions control achieved by the best performing similar facility for new sources and the average of the best performing top 12 percent (or 5 facilities whichever is greater) of similar facilities for existing sources.

Based on the EPA's National Toxics Inventory, the highest emitters of mercury to the air include coal-burning electric utilities, municipal waste combustors, medical waste incinerators, chlor-alkali plants, and hazardous waste combustors. EPA has issued a number regulations under Section 112 to reduce mercury pollution from several of these sources. The U.S. has eliminated the use of mercury in batteries. This action is reducing emissions from waste combustion. In addition, voluntary measures to reduce use of mercury containing products, such as those committed to by the American Hospital Association, will reduce emissions from waste combustion as well. All of these actions together, once fully implemented will reduce mercury emissions caused by human activities by about 50 percent from 1990 levels. The regulations that EPA has put in place to date under Section 112 of the CAA are listed below.

- Municipal waste combustors (MWCs) emitted about 20 percent of total national mercury emissions into the air in 1990. EPA issued final regulations for MWCs on October 31, 1995. These regulations reduce mercury emissions from these facilities by about 90 percent, from 1990 emission levels.

- Medical waste incinerators (MWIs) emitted about 24 percent of total national mercury emissions into the air in 1990. EPA issued emission standards for MWIs on August 15, 1997. When fully implemented, in 2002, EPA's final rule will reduce mercury emissions from MWIs by about 94 percent from 1990 emission levels.

- Hazardous waste combustors (HWCs) emitted about 2.5 percent of total national mercury emissions in 1990. In February 1999, EPA issued emission standards for these facilities, which include incinerators, cement kilns, and light weight aggregate kilns that burn hazardous waste. When fully implemented, these standards will reduce mercury emissions from HWCs by more than 50 percent from 1990 emission levels.

EPA expects to propose a regulation that will limit mercury emissions from chlorine production plants in 2001. In addition, in December 2000, EPA announced that it intends to begin developing a regulation to limit mercury emissions from coal-fired power plants. A proposal is expected in late 2003 and a final regulation at the end of 2004. These plants are the largest source of mercury emissions in the U.S. It is too early to estimate the reductions in mercury emissions that may result from utility regulation. In addition to direct regulation of mercury from power plants we expect to see reduced emissions of mercury from this sector as regulations are implemented to control SO_2 and NO_x as some control technologies used to limit these pollutants collaterally reduce mercury emissions as well. Finally, under the Integrated Urban Air Toxics Strategy, which was published in1999, EPA is developing emissions standards for categories of smaller sources of air toxics, including mercury, that pose the greatest risk to human health in urban areas. These standards are expected to be issued by 2004.

6. Load Allocations

The existing wet deposition load is estimated to be 238.9 $ng/m^2/wk$ (Table 3). Based on the required three-fold reduction in atmospheric mercury loading, a wet deposition target load of mercury from atmospheric sources is 79.6 $ng/m^2/wk$, or an average daily load of 11.4 $ng/m^2/day$ is the target loading rate for both basins.

Dry deposition constitutes approximately 25% of the total deposition in the southeastern United States (Clyde Sweet, National Atmospheric Deposition Program, personal communication). Thus, assuming a total atmospheric load (wet + dry) of 318.5 $ng/m^2/wk$, the estimated existing dry deposition load is 79.6 $ng/m^2/wk$. EPA believes that reductions in wet deposition, which is routinely monitored, will result in proportional reductions in dry deposition. The estimated (three-fold) reduction target dry deposition load is therefore 26.5 $ng/m^2/wk$ or 3.8 $ng/m^2/day$ for all six subsegments.

Table 3 establishes total daily atmospheric loads (wet + dry) based on drainage area for the respective basins.

7. Wasteload Allocations

Point source loading of mercury into waters of the Mermentau and Vermilion-Teche basins is relatively small, approximately 0.6% and 1.5% of existing total loads for the Mermentau and Vermilion-Teche basins, respectively. On a watershed scale these point sources are expected to have a relatively minor effect. However, some point sources, particularly larger discharges into small water bodies may represent significant site specific (local) sources of mercury which could contribute to mercury bioaccumulation. The implementation plan will identify point source discharges which, individually or collectively, may represent significant sources of mercury. Those facilities identified as having reasonable potential for exceeding narrative and/or numeric standards for protection of human health will be required to monitor mercury in their discharges. Mercury loading for these facilities will be controlled through permit limits or through implementation of a mercury minimization plan. Determination of "reasonable potential" would be based on background ambient water concentrations, discharge concentrations, and application of a water quality standard, criterion or other target protective of human health. Through these actions, over the long-term, reductions in mercury loading from point sources are anticipated. Regulations at 40 CFR Part 122.44(d)(1) require permitting authorities to determine "whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a narrative or numeric criterion within a state [or tribal] water quality standard," and to develop water quality-based NPDES permits accordingly.

8. Margin of Safety

A margin of safety (MOS) accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. In this case it accounts for uncertainty and variability related to tissue concentrations, estimates of atmospheric loading and application of the principal of linearity. Monitoring of both fish tissue and atmospheric deposition rates will serve to assess this relationship. These TMDLs incorporate an explicit MOS factored into the safe tissue concentration (=loading capacity). Use of a target tissue level of 0.4 ppm, rather than the critical level of 0.5 ppm, results in a MOS of 20%. An advantage to utilizing a watershed scale approach is that waters which may be threatened by mercury deposition are also protected. However, a limitation of the approach is that basin-specific TMDLs may not sufficiently address long-range emissions which contribute to bioaccumulation of mercury. Regulatory mechanisms to address mercury on a national and/or global scale will be an important factor to reduce such loadings.

9. Seasonal Variation

Wet deposition is greatest in the winter and spring seasons, as indicated by Table 3. Mercury will be expected to fluctuate based on the amount and distribution of rainfall, and variability of local, regional and global sources. While average daily loads are established here, the average annual load is of greater significance since mercury bioaccumulation and the resulting risk to human health which results from mercury consumption is a long-term phenomenon. Thus, daily or weekly inputs are less meaningful than total annual loads over many years. The use of annual load allows for integration of short-term or seasonal variability. Inputs will continue to be estimated through wet deposition monitoring and modeling.

High summer temperatures and static conditions, which lead to stratification, and increased sediment oxygen demand result in hypoxic and/or anoxic conditions which promote methylation. Based on this enhanced methylation and high predator feeding activity during warmer months, mercury bioaccumulation is expected to be greatest during the summer. However, based on the refractory nature of mercury, seasonal changes in body burden would be expected to be slight. Inherent variability of mercury concentrations between individual fish of the same and/or different size categories is expected to be greater than seasonal variability.

10. Reasonable Assurance and Other Relevant Information

Reasonable assurances are needed that water quality standards will be attained. Mercury reductions are expected to occur in a phased fashion over a long-term period. Existing and proposed regulatory controls under the CAA will assure significant reductions in emissions to the atmosphere, and therefore, will result in reduced loadings to the affected basins. Mechanisms to assess and control mercury loads will likely be supplemented or superceded in the future by national TMDL(s), or national guidance which will improve consistency with which EPA and the states establish TMDLs. Because air emission controls will be implemented gradually, the time frame for mercury reductions in key predatory species is expected to take at least two to three decades. The environmental indicators with which to evaluate success will be monitoring of wet deposition rates and fish tissue concentrations of mercury. Monitoring of fish tissue trends will be used evaluate attainment of the narrative water quality standards.

Implementation of these TMDLs will differ from other types of TMDLs since atmospheric deposition--rather than point discharges and non-point runoff--is the focus. The implementation plan should include assurances which may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs.

The majority of the reductions in loading are expected to result from CAA regulatory controls which are implemented on a national basis. State and EPA participation in national initiatives and strategies such as the Mercury Action Plan (EPA 1999) and the Binational Toxics Strategy, will also compliment regulatory efforts. Much monitoring, research and regulation are in progress on the national level. The state will consider these ongoing activities in developing an implementation plan. In addition, modeling will be conducted to assess air emissions (e.g., SAIC 1995).

In 1998 the state initiated three atmospheric monitoring stations in Louisiana under the Mercury Deposition Network Program (MDNP). Continued monitoring of mercury wet deposition is planned since atmospheric sources represent the most significant source of mercury to the water bodies of concern. The data generated from this program will be utilized to assess geographic and seasonal relationships of mercury deposition for the state. The data will be important in establishing a baseline condition and in evaluating wet deposition temporal trends. The stations monitored are considered adequate for assessing loading to the water bodies (and watersheds) of concern. Monitoring of dry deposition is not standardized and thus monitoring and assessment is problematic. However, it is assumed that reductions in wet deposition will also result in proportional reductions in dry deposition.

The state, in conjunction with other stakeholders, may include other forms of monitoring in its monitoring plan. The state has implemented a watershed approach to monitoring. Various types of data and information, including the data collection activities described above, are collected for assessment under Sections 303(d) and 305(b). Monitoring in accordance with the 5-year basin cycle will allow the state to determine whether there has been any improvement on water quality following implementation of TMDLs. As the monitoring results are evaluated, water bodies may be added or removed from the 303(d) list, consistent with the state's listing and de-listing practices.

The ten-year implementation schedule (completion by 2010) recognizes the on-going activities and the difficulties in fully addressing atmospheric mercury loading. This reduction strategy is consistent with the Binational Toxics Strategy, which sets a national challenge of 50% reduction of mercury releases to the air by 2006. This level is therefore set as an interim goal relative to these TMDLs. Long-term monitoring of wet deposition rates and fish tissue will serve as environmental indicators to evaluate the effectiveness of the TMDLs (and other parallel control measures).

11. Public Participation

When EPA establishes a TMDL, 40 CFR §130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of the TMDL to the Court, EPA commenced preparation of the notice seeking comments, information and data from the general and

affected public. The Federal Register notice was issued on April 12, 2000 (Vol. 65, No. 71, p. 19762). Comments were submitted during the 30-day comment period, and the Court-Ordered TMDL was revised accordingly. Responses to comments are available on the EPA Region 6 TMDL website http://www.epa.gov/earth1r6/6wq/tmdl.htm. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into the LDEQ's current water quality management plan.

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Table 1. Description of Segments, Species Under Advisories and Tissue Concentrations.

Segment Name/Description	Seg-ment#	Length or area	Species Under Advisory	Station Number	Average Conc. (ppm)*
Mermentau Basin					
Bayou Plaquemine Brule - Headwaters to Bayou Des Cannes	050201	40 Miles	Bowfin**, Largemouth Bass, Crappie, Freshwater Drum	0504	All 0.848 BF 1.191 LB 1.124 C 0.549 FD 0.860
Bayou Des Cannes - Headwaters to Mermentau River	050101	54 Miles	Bowfin, Black Crappie, Freshwater Drum	0308	All 0.655 BF 0.797 BC 0.494 FD 0.648
Seventh Ward Canal	050702	11.5 Miles	Bowfin, White Crappie, Flathead Catfish, Freshwater Drum	0517	All 0.541 BF 0.537 WC 0.456 FC 0.804 FD 0.600
Mermentau River Basin Gulf Waters to the Three-Mile Limit	050901	Undeter-mined	King Mackerel***	0751	KM 0.815
Vermillion-Teche Basin					
Chicot Lake	060203	2.54 Sq. Miles	Bowfin**, Largemouth Bass	0379	All 0.732 BF 1.101 LB 0.652
Vermillion/Teche River Basin Gulf Waters to the Three-Mile Limit	061201	Undeter-mined	King Mackerel***	0749	KM 0.652

*Concentration for species identified in advisory: All = avg. of all individual samples for species identified in the advisory; BF=bowfin; LB=largemouth bass; FD=freshwater drum; C=Crappie species, BC=Black Crappie; WC=white crappie; FC=flathead catfish; KM=King Mackerel.
**Advisory recommends no consumption of this species and limited consumption of other species listed.
***Advisory recommends limited consumption, and no consumption of larger individuals (>39 inches).

Table 2. Species With the Highest Mercury in Tissue Concentrations.

Water Body	Species With Highest Level	Avg. Mercury Tissue Conc. (ppm)	
Bayou Plaquemine Brule	Bowfin	1.191	("Worst Case Conc.")
Bayou Des Cannes	Bowfin	0.797	
Seventh Ward Canal	Flathead Catfish	0.804	
Chicot Lake	Bowfin	1.101	
Vermillion-Teche Gulf Waters	King Mackerel	0.652	
Mermentau Gulf Waters	King Mackerel	0.815	

Table 3. Mercury Deposition Network Program Data for Louisiana.

Station/Location	Year/Quarter	Weekly Deposition ($ng/m^2/wk$)	Average Weekly Deposition ($ng/m^2/wk$)
LA10 - Chase	1998, 4th Quarter	232.4	
	1999, 1st Quarter	400.8	
	1999, 2nd Quarter	412.0	
	1999, 3rd Quarter	115.1	
	1999, 4th Quarter	123.9	256.8
LA12* - Lake Charles	1998, 4th Quarter	101.6	
	1999, 1st Quarter	221.5	
	1999, 2nd Quarter	401.6	
	1999, 3rd Quarter	341.5	
	1999, 4th Quarter	125.3	238.3
LA28 - Hammond	1998, 4th Quarter	102.5	
	1999, 1st Quarter	272.8	
	1999, 2nd Quarter	209.6	
	1999, 3rd Quarter	392.3	
	1999, 4th Quarter	130.3	221.5
		Overall Avg.	238.9

* Previously identified as NMDP station LA05.

Table 4. Existing and total maximum daily loads for Mermentau and Vermilion-Teche Basins.

River Basin		Estimate of Existing Loads		Total Maximum Daily Load	
Mermentau Basin					
		Annual Load	Daily Load	Annual Load	Daily Load
Loads	Wet Deposition	124.5 kg/yr	(341 g/d)	41.6 kg/yr*	(114 g/d)*
	Dry Deposition	41.5 kg/yr	(114 g/d)	13.9 kg/yr	(38 g/d)
Wasteload (Point Sources)		0.7 kg/yr	(2.01g/d)	<0.7 kg/yr**	(<2.01 g/d)**
Total		166.8 kg/yr	(457 g/d)	56.2 kg/yr	(154 g/d)
Vermilion-Teche Basin					
Loads	Wet Deposition	130.3 kg/yr	(357 g/d)	43.4 kg/yr*	(119 g/d)*
	Dry Deposition	43.4 kg/yr	(119 g/d)	14.5 kg/yr	(40 g/d)
Wasteload (Point Sources)		2.7 kg/yr	(7.39 g/d)	2.7 kg/yr**	(<7.39 g/d)**
Total		176.4 kg/yr	(483 g/d)	60.6 kg/yr	(166 g/d)

*Annual loads are more meaningful for managing bioaccumulation, thus, serve as the target parameter for these TMDLs. The average target wet deposition rate, based on MDNP data, is 11.4 ng/m^2/d for Mermentau and Vermilion-Teche basins. The daily load represents 1/365th of the annual load.
**Some site specific reductions are anticipated through monitoring and controls to address point source discharges which individually or collectively could impact water quality.

Table 5. EPA Toxics Release Inventory (TRI) Mercury Air Emissions Data for Facilities Influencing Mermentau and Vermilion-Teche Basins.

		Annual Loading							
Parish	Facility	1991	1992	1993	1994	1995	1996	1997	1998
Calcasieu	PPG Industries	1222	1260	1290	1230	1240	1230		
Iberville	Dow Chemical Co.	44	130	5	570	230	20		
	Pioneer Chlor-Akali Co.	1297	1286	1290		1246	1204	1204	1205

Table 6. State of Louisiana Toxic Emissions Data Inventory (TEDI) for Facilities Influencing Mermentau and Vermilion-Teche Basins.

		Annual Loading								
Parish	Facility*	1991	1992	1993	1994	1995	1996	1997	1998	1999
Allen	Boise Cascade								910	3
Beauregard	Westvaco		2	2	2	2	2	1		
	Boise Cascade		4	3	61	56	55	48	111	60
Calcasieu	PPG Industries	1210	1208	1238	1282	1287	1281	1228	1220	1222
	CondeaVista							20		
	Lyondell Chemical								0	
E. Baton Rouge	Rodia, Inc.								0	
	Rollins Env.	1	2	2	9	9				
	Safety-Kleen								0	0
	Georgia Pacific		83	81	143	73	69	73	70	2
Iberville	Dow USA 44	127		588	227	16			1	
	Novartis								3	15
La Salle	La.-Pacific 2	2	2	2	2				3	
Natchitoches	Willamette		21	20	15	15	16	16	16	
Rapides	Internat. Paper		45	46	47	2	95	60	57	60
St. Mary	Marine Shale	30	25	22						
West Feliciana	Crown Paper					29		20	20	29
	James River		14	27	27					

*Emission values summed for multiple SIC codes applicable to given facilities.

Figure 1: National Mercury Deposition Program (NMDP) Sites and Water Bodies Listed for Mercury in the Mermentau and Vermilion Basins